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Factors associated with birth weight patterns in northern west bank†

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Abstract

Infants with low birth weight (LBW) < 2.5 Kg and large gestational weight (LGA) > 4 Kg are conditions that are linked to infant mortality and future decline in wellbeing. This study aimed to evaluate factors that are associated with both LBW and LGA among a group of pregnant women in Nablus in the northern West Bank. The study involved 387 pregnant women who were recruited from Palestinian Ministry of Health outpatient clinics during 2017-2018. Data were collected using a self-administered questionnaire that included questions about demographic data and birth outcomes. Data regarding anthropometric height and weight to calculate the body mass index (BMI) and weight gain during each trimester were collected from the women files. Data was analyzed by SPSS.15.3% and 9.7% of the newborns were LBW and LGA, respectively. Both anemia and smoking increased the risk of having LBW ($p< 0.05$). Parity, gravidity, and diet were all related to LBW risk. Younger age and diet protected from having LGA infants ($p< 0.001$). LBW and LGA are common in Northern West Bank region of Nablus. Health education could help decrease the risk.

Keywords: Low birth weight, large birth weight, weight gain, newborn

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INTRODUCTION

In developing countries, low birth weight (LBW) contributes to significant mortality and morbidity during infancy [1]. The estimated prevalence of low birth weight in developing countries is 15.9% in 2010-2013. Older maternal age, inadequate antenatal care, lower socioeconomic status, and education were all important factors that predicted having a low birth weight newborn. LBW is defined as having a birthweight that is less than 2500 g regardless of gestational age [2]. Due to the high morbidity associated with LBW, it is usually associated with an increase in the cost of health care for the affected newborns, which could be a burden to affected developing countries [3]. According to Palestinian Bureau of Statistics, the rate of having low birth weight in West Bank is 8.4% in 2014 [4]. Very few studies were carried out to evaluate the patterns of LBW among Palestinian population. A study by Halileh et al. before 2008 showed that sex of the newborn, order, maternal age, and education were the most important factors that determine the BW of the baby, with LBW being 9% among females and 5% among males [5].

Large for gestational age infants (4000 g) (LGA) is associated with increased risk of obstetrical outcomes and future metabolic deficits including obesity and lower development attainment later in life[6]. The quality of maternal diet during pregnancy was associated with both LBW and LGA among a large cohort of Norwegian mothers [7]. In a study among Brazilian newborns: family income, pre-pregnancy BMI, and excessive gestational weight gain were associated with an increase in LGA prevalence [8].

In a recent systematic review of many studies, maternal anemias in the first and second trimesters of pregnancy were linked to having low birth weight[9]. Anemia is widespread in Palestinian territories. More than 36% of pregnant women were found to have hemoglobin less than 10 mg/dL [10]. In a study among pregnant women in Hebron, there was a significant association between maternal anemia and low birth weight[11]. Anemia was not studied in relation to LGA, but poor dietary habits and nutrition transition coexist with obesity in developing countries [12]. It is important to understand the relationship between obesity, weight gain, anemia, and birth weight.

Increased birth weight was linked to poor dietary habits that scored a low healthy eating index[13]. At the same time, adherence to healthy eating habits was protective from having LBW, which indicated the dual importance of dietary habits among pregnant females[14]. However, study examining the association between diet practices and birth weight was not studied among Palestinian population. Hence, the goals of the study were: 1) To study the patterns of birth weight in relation to gestational weight gain and different BMI categories. 2) To identify risk factors for LBW and LGA among a group of Palestinian women from Nablus region. 3) To determine the association between dietary practices and birth weight among the same study group.

METHODS

Study Sample

Utilizing a quantitative cross-sectional study design, 387 pregnant women were randomly selected using a stratified proportional sampling method from the total population who were registered for antenatal care at the major Ministry of Health (MOH) four clinics (Balata, Al Markazi, Al Makhafia and Raas Alaein clinics) for a year 2017 as per Table 1.

Table (1): Distribution of population number and sample size according to clinics.

Clinic	Balata	AlMarkazia	AlMakhafia	RaasAlaein	Total
Population	204	403	100	189	896
Sample size	89	174	43	81	387

Data Collection

A self-administered questionnaire was used to collect data on demographics, diet, obstetric history, physical activity performance, and knowledge about weight gain during pregnancy. BMI was calculated using height and weight, and weight gains during each trimester were collected from the women' files using a data collection form. Both questionnaire and data collection forms were developed by the study authors based on previous literature with details published elsewhere [15] . Validity and reliability were checked by experts. A pilot study was run with about 5% of the sample size (n=19) and Cronbach alpha was computed with a result of (0.90, 95% CI (0.82-0.95).

The study was approved by the Institutional Review board (IRB) committee of An-Najah National University and by MOH that permitted access to antenatal clinics and hospitals. In addition, a signed written consent form was used to ensure the conformity of pregnant women participating in the study.

Field work

The study was run over a period of 10 months from the end of September 2017 to the end of July 2018 during the workdays of MOH from Sunday to Thursday. Five visits were made to each clinic: the first one explained the purpose of the study to pregnant women who met the inclusion criteria. In addition, height and weight were measured and the questionnaire was filled. The second, third, and fourth visits were held at the end of each trimester to measure the weight of the file registration number to avoid doubling of any women. In the last visit, the maternal and fetal outcomes data were collected from files and the registration book of hospital delivery. It was also used to identify the potential related complications.

Statistical method S and data analysis

The Statistical Package for Social Science (SPSS) was used to analyze the data. Gestational Weight Gain (GWG) was calculated and classified according to the IOM recommendations as Inadequate GWG, Adequate GWG, and Excessive GWG. BMI was calculated and classified according to WHO recommendations.

Table (2): IOM recommendations for weight gain pregnancy.

Category	BMI	Weekly gain Gram per week (range)	Total weight gain Range
Under weight	<18.5	453 g (453 -589)	28-40 Ibs (12.5 -18kg)
Ideal weight	18.5- 24.9	453g(362 -453)	25 -30(Ibs11.5-16 kg)
Over weight	25-29.9	276 g(226 -317)	15-25 Ibs(7-11.5 kg)
Obese	>30	226 g(181 -272)	11-20 Ibs (5-9 kg)

The relationship between various study factors including birth weight as a dependent variable and independent variables including age, BMI, weight gain, parity, gravidity, anemia, and smoking were analyzed using logistic regression models, with binary outcomes being LBW versus normal birth weight and normal birth weight versus LGA as outcome 2. For outcome 1, we had n=343 participants included in the analysis with data for all variables. For outcome 2, we had data available for n=322 participants. The total number of participants included in the analysis was 380.

RESULTS

In a study among 380 pregnant women from Nablus region in Northern West Bank, 15.3% of the newborn infants had LBW, whereas 9.7% of newborn infants had a birth weight> 4 kg. Data on demographic and other health characteristics of this study sample was published in a work currently under peer review. There was not a significant difference of LBW and LGA according to newborn sex (data not shown). However, as shown in Table 3, infants with LBW were more common among women with inadequate weight gain during pregnancy (chi-square= 14.38, p-value=0.006), whereas having LGA infants was the least common in this weight gain category. On the other hand, having a baby with normal birth weight was most common among women with BMI 18.5-24.9 and 25-29.9 Kg/m2 (Chi-square= 12.65, p-value=0.05) (Table 4).

Table (3): Distribution number and percentage of participant's infant birth weight according to their weight gain category.

Weight Gain Category		Birth Weight*		
		≥ 5 Kg	2.5-4 Kg	>4 Kg
Inadequate	**No.**	34	124	8
	%	20.5	74.7	4.8
Normal	**No.**	18	99	20
	%	13.1	72.3	14.6
Excessive	**No.**	6	62	9
	%	7.8	80.5	11.7
Total	**No.**	58	285	37
	%	15.3	75	9.7

Pearson chi-square= 14.4
*p-value= 0.006.

Table (4): distribution of numbers and percentages of participants' infant birth weight according to maternal BMI categories.

BMI (Kg/m^2) Category		Birth Weight*			Total
		>2.5 Kg	2.5-4 Kg	<4 Kg	
<18.5	No.	2	7	3	12
	%	16.7	58.3	25.0%	100.0
18.5-24.9	No.	36	148	14	198
	%	18.2	74.7	7.1%	100.0
25-29.9	No.	11	82	8	101
	%	10.9	81.2	7.9%	100.0
>30	No.	9	48	12	69
	%	13.0	69.6	17.4%	100.0
Total	No.	58	285	37	380
	%	15.3	75.0	9.7%	100.0

Pearson chi-square= 66.1
*p-value< 0.0001.

Factors related to LBW

Table 5 shows the multiple logistic regression associations between various demographic and health factors in LBW. Being in the age category 26-32, y reduced the risk of having LBW, but did not reach statistical significance (p=0.08). There was a 3% increase in the risk of having LBW among infants born to mothers with anemia. Smoking increased the risk of LBW by more than 4 times. Having a fewer number of babies seemed to increase the risk of LBW (both parity and gravidity were significantly related to LBW). Finally, having inadequate weight gain during pregnancy significantly increased the risk of having LBW.

Table (5): Multiple logistic regression predictors of low birth weight infants.

Reference group	Variables' Subcategories	OR (95% CI)	*p-value*
Age: > 41 y	17-25 y	.34 (0.34,27.0)	0.32
	26-32 y	.84 (0.84, 60.0)	0.07
	33-41 y	.35 (0.35, 25.8)	0.32
BMI: >30 Kg/m^2	Less than 18 Kg/m^2	.08 (0.08,3.61)	0.52
	18-24.9 Kg/m^2	.29 (0.29, 2.10)	0.61
	25-29.9 Kg/m^2	.37 (0.37, 3.29)	0.86
Residence: City	Village	.57 (0.57, 2.61)	0.61
	Camp	.42 (0.42, 3.18)	0.78
Anemia ;	Anemia(No versus yes)	1.03 (1.03, 3.70)	0.04
Smoking;	Smoking(No versus yes)	.234 (0.23, 0.93)	0.03
Gravidity ;4	1	.68 (0.68,13.42)	0.15
	2	1.0 (0.996, 11.22)	0.051
	3	.77 (0.77, 10.60)	0.012
	More than 4	1.94 (1.94, 61.64)	0.007
Parity; More than 6	No one	.01 (0.007, 0.662)	0.02
	1-3	.012 (0.01, 0.92)	0.04
	4-6	.023 (0.023, 1.60)	0.127
Excessive GWG	In-adequate GWG	.101 (0.10, 0.80)	0.02
	Normal GWG	.168 (0.20, 1.40)	0.17

In terms of dietary relationship to LBW, regular consumption of meat seems to protect from LBW, but this did not reach statistical significance. Consumption of fast food could be linked to LBW (Table 6).

Table (6): Multiple logistic regression predictors of large birth weight infants.

Reference group	Variables	OR (95% CI)	p-value
Age: Above 41 y	17-25 y	5.3 X 10^2 (14, 2.0 X10^4)	0.001
	26-32 y	1.9 X 10^2 (6.2-6.2X10^3)	0.003
	33-41 y	1.84 X 10^2 (5.4-6.3 X 10^3)	0.004
BMI; More than 30 Kg/m^2	Less than 18 Kg/m^2	.53 (0.08, 3.48)	0.50
	18-25 Kg/m^2	1.02 (0.31, 3.41)	0.97
	26-30 Kg/m^2	1.86 (0.54, 6.34)	0.33
Residence: City	Village	1.56 (0.59, 4.11)	0.37
	Camp	23.09 (1.08, 496.3)	0.05
Anemia	Anemia(no vs. yes)	1.73 (0.73, 4.06)	0.21
Smoking	Smoking(no vs. yes)	.65 (0.27, 1.57)	0.34
Gravidity: = 4	1	.18 (0.01, 4.98)	0.31
	2	.13 (0.01, 2.65)	0.19
	3	.19 (0.01, 3.23)	0.25
	More than 4	131352010.094	0.99
Parity: > 6	No one	.08 (0.002, 3.44)	0.19
	1-3	.20 (0.007, 5.33)	0.34
	4-6	.005 (0.00, 0.21)	0.006
Excessive weight gain	Inadequate weight gain	1.68 (0.52, 5.51)	0.39
	Normal weight	.65 (0.24,1.81)	0.41
	Constant	**1.500**	

Factors related to LGA

Table 7 shows various factors linked to LGA in multiple logistic regression models. Being older than 41 y significantly increased the risk of LGA relative to other age categories. Being in a refugee camp decreased the risk of having LGA. Parity and gravidity did not seem to be linked to having LGA, except for women who had 4-6 pregnancies, which increased the risk of LGA. Weight gain and pregestational BMI were not related to LGA in fully adjusted models.

Table (7): Multiple logistic regression dietary predictors of low birth weight.

Variables	No. of eating	OR (95% CI)	*p-value*
Vegetables	Never	ref	0.79
	1-2	1.21 (0.09, 17.0)	0.89
	3-4	0.53 (0.04, 6.93)	0.63
	5-6	0.66 (0.05, 9.68)	0.76
	Daily	0.72 (0.06, 9.12)	0.80
Meat	Never	ref	0.28
	1-2	1.84 (0.61, 5.55)	0.28
	3-4	3.09 (0.88, 10.83)	0.08
	5-6	5.76 (0.65, 51.25)	0.12
	Daily	3.34 (0.86, 13.03)	0.08
Dairy	Never	ref	0.19
	1-2	1.86 (0.70, 4.90)	0.21
	3-4	1.66 (0.53, 5.18)	0.38
	4-5	2.24 (0.44, 11.37)	0.33
	5-6	4.26 (1.32, 13.74)	0.02
	daily		0.09

Variables	No. of eating	OR (95% CI)	*p-value*
Carbohydrate	Never	ref	
	1-2	1.05 (0.17, 6.48)	0.96
	3-4	1.42 (0.22, 8.96)	0.71
	5-6	0.61 (0.08, 4.85)	0.64
	daily	2.93 (0.54, 15.83)	0.21
Fast food	Never	ref	0.08
	1-2	0.32 (0.14, 0.70)	0.005
	3-4	0.72 (0.21, 2.47)	0.60
	4-5	0.59 (0.07, 4.85)	0.62

In terms of diet (Table 8), regular intake of vegetables was a protective LGA, whereas regular intake of dairy increased the risk. Although high consumption of meat and carbohydrates tended to increase weight gain, this did not reach statistical significance.

Table (8): multiple logistic regression predictors of large birth weight infants.

Variable	Frequency of eating	OR (95% CI)	*p-value*
Vegetables	Never	ref	
	1-Feb	507.4 (9.92, 2.59 X 10^4)	0.002
	3-Apr	5.19 X10^2 (9.53-2.82X10^4)	0.002
	5-Jun	1.23 (1.92-7.89X10^3)	0.023
	Daily	1.13X10^2(3.47-3.69 X10^3)	0.008
Meat	Never	ref	
	1-Feb	0.63(0.10, 3.83)	0.62
	3-Apr	0.31(0.05-2.14)	0.24
	5-Jun	0.12 (0.01-1.43)	0.09
	Daily	0.32 (0.05-2.35)	0.26
Dairy	Never	ref	
	1-Feb	1.28 (0.22-7.43)	0.79
	3-Apr	1.02 (0.15-6.95)	0.98
	5-Jun	1.34 (0.08-22.75)	0.84
	Daily	0.13 (0.03-0.62)	0.01
Carbohydrate	Never	ref	
	1-Feb	6.86 (0.53-88.71)	0.14
	3-Apr	7.62 (0.56-1.04X10^2)	0.13
	5-Jun	5.43 (0.15-2.01X10^2)	0.36
	Daily	6.74 (0.71-64.41)	0.098

DISCUSSION

In a representative sample of pregnant women from Nablus region, 15.3% of the newborns were smaller than 2.5 Kg, whereas 9.7% were larger than 4 Kg. In case of LBW, anemia, smoking, parity, gravidity, and gestational weight gain were important factors. On the other hand, in case of LGA, maternal age, gravidity, and place of residence were important factors. On the other hand, regular consumption of vegetables protected infants from increased weight, whereas daily consumption of dairy products increased the risk of having LGA infants. Regarding diet and LBW, dairy intake protected from LBW, whereas fast food increased the risk. Education and income were not included in the analysis because in the previous analysis, they were not significant determinants of LBW and LGA.

The rate of low birth weight in the nearby country Jordan was 18% in recent published work which is slightly higher than our study, whereas studies in other developing countries show high rate of LBW as high as 27% [16]. In 2014, the prevalence of low birth weight in Israel was 8.1%, which much lower than our study [17]. The factors that seem to contribute to LBW in developing countries include advanced maternal age, lack of antenatal care, primiparity, illiteracy, and lower socioeconomic status[2]. In no preliminary analysis in our study, we did not find a relationship between education, income, and LBW. The reason for this finding could be the fact that in general Palestinian population income is very much lower than Israeli income. Moreover, not very many women in this study achieved high education.

Anemia during pregnancy significantly increased the risk of LBW. In meta-analysis of 17 studies, anemia during the first trimester increased the risk of LBW by 26% [9]. Anemia during pregnancy is defined as having hemoglobin level lower than 11 g/dL in the first and second trimester and lower than 10.5 in the third trimester [18]. The prevalence of anemia in our study was 36.9% as was shown previously[19]. Anemia during pregnancy could lead to decrease in food intake and decrease iron provision for the fetus which could contribute to lower birth weight [20]. It is more likely that anemia during pregnancy among Palestinian women is more related to iron deficiency, however, more studies are needed to evaluate the contribution of other micronutrients deficiencies to the high prevalence of anemia among Palestinian pregnant women.

Other factors that contribute to LBW are smoking and dietary habits, indicating the importance of lifestyle factors on the health of newborn infants. In other studies published in the USA, smoking almost doubled the risk of having LBW [21]. Smoking effect on birth weight is mediated by nicotine which induces catecholamines with a net decrease in placental flow and decrease in oxygen and nutrients delivery to the placenta causing intrauterine growth restriction [21]. Smoking is common in Palestinian society including cigarette smoking and water pipe smoking[22]. Regarding diet, intake of dairy seems to protect from LBW, whereas fast food seems to increase the risk of LBW. A proinflammatory diet was shown to increase the risk of having preterm and LBW among a group of pregnant women from Japan [23]. Western diet that includes fast food and high energy intake is well known to be a diet that provokes inflammatory responses in the human body [24].

Having a baby heavier than 4 kg was present among 10% of the studied participants. Fetal macrosemia or LGA is associated with both maternal and infant complications that were described elsewhere and its definitions vary between studies. In this work, we defined LGA as having a newborn infant who is> 4 kg [25]. The delivery of LGA usually reflects both genetic factors and the intrauterine growth environment [26]. Maternal obesity and diabetes mellitus are two conditions that are well described in the literature to cause LGA [27]. In this study, maternal BMI and gestational weight gain were not related to having LGA infants. Whereas being younger and eating more vegetables seemed to protect from LGA.

In our study, LBW was increased with having less than 4 baby relative 4. After the 4^{th} baby, the risk of LBW is increased again. Although LBW increases with parity until the 4^{th} baby, this relationship also depends on maternal weight and time between each pregnancy[28]. According to Palestinian Bureau of Statistics, the average size of Palestinian families is 5.5 [29].

Maternal BMI was not significantly related to birth weight in fully adjusted models. In a study among Chinese women, both BMI and fat free mass were significantly related to birth weight[30]. Moreover, in a study among Indian women, low maternal BMI was significantly related to LBW as having low BMI and adequate weight gain may lead to inadequate supply of nutrients to the fetus [31]. May be the relationship was diluted by multiple adjustments and needs more sample size to be detected.

This work emphasizes the importance of healthy weight gain during pregnancy and healthy weight prior to pregnancy in achieving healthy birth weight of newborn infants. In his paper, Almond et al. described the cost of low birth weight as it is associated with wellbeing of infants in early life and relation to infant mortality [3]. Having low birth weight infants is associated with a variety of health issues beyond the scope of this paper. In addition, having an infant with a large birth weight is associated with having obesity and chronic diseases later in life.

This study was a comprehensive evaluation of many factors in association with categories of birth weight in Nablus in Northern region of West Bank. We included women from the main cities, surrounding villages, and refugee camps. However, our study underrepresented females from refugee camps due to barriers in access to refugee camp UNRWA clinics. Moreover, this study is cross-sectional in design and so we cannot draw causal relationships. We used categorical variables in our adjusted models.

CONCLUSIONS

In summary, among a group of pregnant women and their newborns, there was a high prevalence of LBW and LGA. Factors that increased LBW included smoking, anemia, having fewer babies than 4,4 or more than 4 and inadequate gestational weight gain. Other factors, such as being from refugee camp decreased the risk of LGA, whereas having more than 4 pregnancies increased the LGA. Finally, healthy dietary habits were protected from abnormalities in birth weight. Hence, we conclude lifestyle and nutritional measures could help to protect from abnormalities in birth weight. This work is of valuable importance for the Palestinian society because having low birth weight infants increase the risk of future morbidity, mortality and increase the financial burden on society and healthcare. Having larger is also not without risks including DM2 and obesity as was mentioned earlier in this paper.

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